Regional strain differences in tendon – the missing link that explains failure of the reconstructed ACL

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ABSTRACT
Anterior Cruciate Ligament (ACL) rupture is a common ligament injury in physically active patients, and is usually treated with ACL reconstruction (ACLR). With this method, tendon autografts are harvested and inserted in the knee, taking over the initial ACL function. Over the past years, the failure rate of ACLR in active, young athletes rapidly increased.

The aim of this study is to investigate whether hypothesized heterogeneous regional strain distribution in stretched tendons can explain ACLR failure. For method development, porcine plantar flexor tendons were analysed. A speckle pattern was applied to isolated tendons before tensile testing. By performing speckle pattern analysis on video recordings of the tensile test, local strain values were calculated. In a developed MATLAB model, these local strain values were visualised in heat maps. The model was validated with an existing Excel model. To eventually visualise regional strain distribution in human tendons, surgical waste material of hamstring tendons was analysed in the developed model.

Results show that both porcine plantar flexor tendons and (parts of) human hamstring tendons show heterogeneous local strain distribution. In the future, insights in heterogeneous strain distribution in hamstring tendons can help surgeons to construct optimal ACL grafts, reducing failure of the reconstructed ACL.

GRAPHICAL ABSTRACT

Explain ACLR failure